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ABSTRACT

The D-48 and D-70 (Dominoes) Tests, which are parallel forms of a non-verbal, cross-cultural test, were administered to 82 college students and 112 high school freshmen. Criterion scores were obtained on the Otis Quick Score and grade point average for the college students, and the Iowa Test of Basic Skills for the ninth-graders. Results showed a correlation of .69 and .70 for college students and high school students respectively between the parallel forms of the test. Other results indicated equal means and standard deviations of the two tests and equal correlations with the outside criteria for both groups of subjects. Internal consistency reliability was considered adequate for both tests. The summary of results supported the parallelism of the two forms of the test. (Author)

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Reliability and Validity of Alternate Forms of the Dominoes Test (D-48 and D-70)

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Abstract

The D-48 and D-70 (Dominoes) Tests, which are parallel forms of a non-verbal, cross-cultural test, were administered to 82 college students and 112 high school freshmen. Criterion scores were obtained on the Otis Quick Score and grade point average for the college students, and the Iowa Test of Basic Skills for the ninth-graders. Results showed a correlation of .69 and .70 for college students and high school students respectively between the parallel forms of the test. Other results indicated equal means and standard deviations of the two tests and equal correlations with the outside criteria for both groups of subjects. Internal consistency reliability was considered adequate for both tests. The summary of results supported the parallelism of the two forms of the test.

Reliability and Validity of Alternate Forms of the Dominoes Test (D-48 and D-70)[1]

Cross-cultural tests have been of recurring interest to test users for a considerable period of time. This persistent notion of a "culture free" or "culture fair" test has been explored by many researchers, but development of a test free from cultural bias has proved to be an elusive outcome. Anastasi (1976, p. 296) addresses the problem of the development and use of cross-cultural tests and states that the basic approach to development of a cross-cultural test is through the " . . . choice of items common to many cultures and the validation of the resulting test against local criteria in many different cultures."

Many tests have been developed with items that are ostensibly non-verbal in nature and that can be used across a variety of cultures. These tests are considered to be measures of a general intellectual factor (g). Some examples of cross-cultural tests that are measures of general aptitude and which have concentrated on a non-verbal item format are the Progressive Matrices (Raven, 1963) and the Culture Fair Intelligence Test (Cattell, 1959). These tests have been widely used for many cross-cultural studies. Another test with a non-verbal format that has been used widely in Europe but not the United States, and that uses items in the form of dominoes is the

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D-48 Test (Black, 1961). The D-48 or Dominoes Test was developed in England, later adopted in France, and used for personnel selection in the British Armed Forces during World War II. It has been used for over thirty years in Europe, and has been used to some extent in some South American and the near-Eastern countries. In the United States the D-48 is still considered a research instrument. Some United States researchers using the D-48 test with diverse subject populations include Gough and Domino (1963), Domino (1964), Welsh (1966), Boyd & Ward (1966 & 1967), Cantwell (1966), Welsh (1967), Karnes (1968), Chissom & Lightsey (1971), McLaurin et al. (1973), Chissom et al. (1972), and Chissom & Hoenes (1976). Reports of research using subjects from countries other than the United States that have appeared in English language publications are by Keehn and Prothro (1955), Rafi (1967), Kagitcibasi (1972), and Handel (1973).

An inadequacy of the D-48 Test that has been mentioned by its European users has been the absence of a parallel form. The test has become familiar to examinees due to its widespread use, and its security and usefulness have been questioned. In response to these problems with the D-48, a parallel form was constructed by the Centre de Psychologie Appliquee (Kowrousky & Rennes, 1970) in Paris and was named the D-70 Test by its authors. A Spanish translation of the D-70 manual has been made by Tecnicos Especialistas Asociados (1976). The test has been normed more extensively with

a large number and variety of Spanish subjects, but the original development of the test was performed with French populations.

Since little or no information is available about the D-70 Test used with subjects in the United States, the objective of this study was to investigate the equivalency of the D-48 and the D-70 Tests for American subjects.

METHOD

Subjects

Two groups of subjects were selected for the study. One group was composed of 82 university students enrolled in an introductory course in Educational Psychology. There were 73 females and 11 males in the group; their mean age in months was 255.4 (21.3 years) and they were classified at the third year or junior level.

The second group of subjects was 112 ninth graders from a South Texas community with a large Hispanic population. There were 89 females and 23 males, their mean age in months was 185.4 (15.5 years), and there were 96 subjects classified as Mexican-American on the basis of surname. The group was not subdivided for analysis according to cultural background because of the difficulty in determining the extent of Hispanic or American cultural influence on individuals. The authors felt that ethnic classification by surname was insufficient evidence for that purpose.

Measures

Both the D-48 and D-70 Tests consist of 44 items all of which use dominoes arranged in such a way that they constitute a problem to be solved. Four example problems are presented first, the tests have a twenty-five minute time limit, and the items are arranged in order of difficulty with the easier items first. In developing the D-70 Test, items were selected to parallel the D-48 items both in regard to item difficulty and the type of problem to be solved.

The group of university students was administered the D-48 Test and the D-70 Test in alternate order to negate a possible increase in score that might have occurred if one test had always been given first. The increase in performance on the second test was evidenced during the construction and validation of the D-70 with French subjects. In addition, the Otis Quick Score (Otis, 1954), was administered to all subjects and a measure of the grade point average (GPA) based on a four point scale (A=4.0) was collected from each subject. The Otis Quick Score (OQS) was used because it had been used previously in several studies involving the D-48 Test.

The group of high school freshmen was also administered the D-48 and D-70 Test in alternate order to counteract the learning effect. Additional scores of each subject on five subtests of the Iowa Tests of Basic Skills (ITBS) (Lindquist et al., 1956)

were obtained from school records. The subtests were Reading (total), Language (total), Mathematics, Social Studies, and Science.

Results

Table 1 contains the means and standard deviations of all the variables used for the two groups of subjects. An inspection of the table indicates that the means and standard deviations of

Insert Table 1 about here

the D-48 and D-70 Tests were nearly identical. No significant differences were obtained when comparing the means of the two forms for both groups. This evidence provided a positive indication of the equivalence of the two tests.

Reliabilities for the D-48 and the D-70 Test were computed by the odd-even, split-half method corrected by the Spearman-Brown formula, and using the Kuder-Richardson Formula 20. The reliabilities for both groups are presented in Table 2.

Insert Table 2 about here

The resulting reliability estimates ranged from .69 to .90. These results, with the exception of the somewhat low estimate of .69 for the ninth graders using the split-half method, seems to indicate adequate internal consistency reliability of the two forms of the test.

Correlations of the two sets of test scores obtained for the D-48 and D-70 for both groups of subjects provided further evidence of the equivalence of the two tests. The intercorrelations of the variables for the university students are given in Table 3, and the intercorrelations of the variables for the ninth graders are presented in Table 4. The correlation between the D-48 and D-70

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Insert Tables 3 & 4 about here

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for the university and ninth-grade subjects were .69 and .70 respectively. These results are somewhat less than might be expected for the correlation between parallel forms of a test.

The significant negative correlation between both forms of the Dominoes Test and the age variable, for both groups of subjects, did not support other research findings indicating the developmental nature of the test, and most recently documented by Handel (1973). It would seem that scores on the test decline with advancing age. Another explanation of the negative relationship is that

older students in both groups represented lower levels of aptitude. The lack of correlation between the test scores on the D-48 and D-70 and the sex of the individual indicated a lack of sex bias.

In examining the relationship between the D-48 and D-70 Tests and the OQS criteria, the high positive and significant relationship between the two forms of the Dominoes Test and the OQS indicated that the tests are not entirely non-verbal. These results were in keeping with the studies by Boyd & Ward (1966 & 1967), and McLaurin et al. (1973) in which the D-48 was compared to the OQS using college students as subjects. Further, the lack of relationship with the GPA was similar to the findings in the studies by Chissom et al. (1972) and McLaurin et al. (1973).

The correlation between the D-48 and the D-70 Tests and the five subtests of the ITBS for the ninth graders were all significant and similar in magnitude. The differences in correlations varied from .01 on the Language subtest to .04 on the Mathematics subtest. The significant correlations between the verbal subtests of the ITBS and the two Dominoes Tests added further evidence to point to the somewhat verbal nature of a test designed to be non-verbal. The ability of the tests to predict academic achievement has been demonstrated for the D-48 with Turkish students by Kagitcibasi (1972), for the D-48 with American children by Chissom & Hoenes (1976), and reported in the Spanish translation of the D-70 manual, for groups of Spanish students 16-18 years of age (Technicos Especialistas Asociados, 1976). The evidence

of correlations of similar magnitude for both forms of the test with the same criteria further indicated the equivalence of the D-48 and the D-70 tests.

When investigating the D-48 Test, several authors (Gough & Domino, 1963; Rafi, 1963; Welsh, 1967; Chissom & Lightsey, 1971; and Handel, 1973), have reported the correlation between item rank and item difficulty in order to provide evidence of the ordering of items by difficulty. Table 5 presents the results of the rank-order intercorrelations of item difficulties for both forms of the Dominoes Test and the theoretical rank order of the items from 1-44. Results of the analysis indicated a high degree of relationship between the rank order of items and

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Insert Table 5 about here

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the rank order of item difficulties. These results are similar to the previously mentioned studies in which rank-order of item difficulties was examined. However, the relatively low degree of relationship (.65-.68) between the rank order of the item difficulties for the two forms of the Dominoes Test indicated some lack of equivalence in the order of items ranked according to difficulty level.

Summary

In summarizing the evidence obtained from this study, it was clear that the two forms of the Dominoes Test are basically equivalent. Equality of means and standard deviations and equal correlations with outside criteria all supported the parallelism of the two tests. Internal consistency reliability of the two tests was considered adequate. In addition, the evidence presented in this study is in close agreement with the information presented in both the French and Spanish versions of the manual for the D-70.

Some results of the study can be considered as negative and might be interpreted as indicating the lack of equivalence between the two test forms. First, the relatively low (.70 and .69) correlations between the two forms of the Dominoes Test, and second, the relative lack of agreement between the rank-order of their item difficulties. However, the total evidence supported the equivalence of the tests and presented an overall picture similar to the one provided by the French and Spanish manuals.

The D-48 Test has been in use for a considerable period of time and has been recommended to researchers throughout the world as an instrument to be used for cross-cultural comparisons. The results of this study document that the D-70 is a parallel form of the D-48, and consequently should enhance the usefulness of both measures. It is recognized that more normative and validity

information for both tests is necessary before they can be used over a large number of cultural groups. The fact that the measures are equivalent greatly enlarges the possibilities for their use, and provides researchers with additional tools to use in attacking problems associated with cross-cultural comparisons.

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Table 1

Means and Standard Deviations

For University Students (N=82) and Ninth Graders (N=112)

On All Variables

	University Students		Ninth Graders	
Variable	$\bar{x}$	s	$\bar{x}$	s
Age (in months)	255.36	40.04	185.40	8.76
D-48	31.96	5.70	22.33	6.16
D-70	31.93	5.24	22.48	6.22
Otis Quick Score	56.30	10.10		
Grade Point Average	2.85	.53		
ITBS Reading			28.50	12.41
ITBS Language			30.93	11.71
ITBS Math			8.47	3.80
ITBS Social Studies			14.27	4.66
ITBS Science			16.28	6.99

Table 2

Reliabilities of the D-48 and D-70 Tests

	University Students		Ninth Graders	
Test	Split-half	KR20	Split-half	KR20
D-48	.89	.85	.90	.85
D-70	.88	.83	.69	.86

Table 3

Intercorrelations of all Variables

for University Students (N=82)

Variables	Sex	Age	D-48	D-70	OQS	GPA
Sex	--	.32**	.19	.08	.07	.28*
Age		--	-.29**	-.32**	-.25*	.12
D-48			--	.69**	.56**	.18
D-70				--	.70**	.04
OQS					(.92[a])	.25*
GPA						--

[a]Reliability computed by the corrected split-half method

*p<.05

**p<.01

Table 4

Intercorrelations of all Variables

for Ninth-grade Students (N=112)

Variables	Sex	Age	D-48	D-70	Rdg.	Lang.	Math	Soc.St.	Sci.
Sex	--	-.09	.12	.02	.15	.26**	-.10	.20*	-.02
Age		--	-.22*	-.24*	-.37**	-.34**	-.20*	-.26**	-.29**
D-48			--	.70**	.39**	.44**	.46**	.33**	.41**
D-70				--	.41**	.43**	.50**	.35**	.44**
ITBS Rdg.					--	.76**	.59**	.79**	.83**
ITBS Lang.						--	.50**	.67**	.65**
ITBS Math							--	.52**	.56**
ITBS Soc. Stud.								--	.65**
ITBS Sci.									--

*$p<.05$

**$p<.01$

Table 5

Rank-order Correlations of

Item Difficulties for

D-48 and D-70 Tests

	D-48		D-70	
Rank	Univ. Stu.	9th Gr.	Univ. Stu.	9th Gr.
Rank (44-1)	.89	.90	.83	.86
D-48 Univ. Stu.	--	.97	.68	.68
D-48 9th Grade		--	.65	.67
D-70 Univ. Stu.			--	.96
D-70 9th Grade				--